# COMMUTING AND THE RESIDENTIAL DECISIONS OF CHICAGO AND DETROIT CENTRAL BUSINESS DISTRICT WORKERS

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# COMMUTING AND THE RESIDENTIAL DECISIONS OF CHICAGO AND DETROIT CENTRAL BUSINESS DISTRICT WORKERS

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## I. INTRODUCTION

During recent years, people interested in the well-being of urban communities have given increasing attention to urban transportation problems. In particular, they have been concerned with the plight of central business district commuters and the difficulties and costs confronting large central cities that wish to provide highway access facilities for the increasing numbers of automobile commuters. Many people regard automobile commuting to central areas as prohibitively expensive for both the individual and the community. Noting the apparent ability of rapid transit systems in Chicago, Cleveland, New York, and elsewhere to maintain peak-hour ridership (even though suffering declines in over-all ridership), planners and community leaders in San Francisco-Oakland, Washington, D.C., Los Angeles, and

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a number of other urban areas have proposed the construction of new rail rapid transit systems for their cities.*

All these plans would involve substantial subsidies from non-users to users even though there is normally no specific justification for such subsidies; on the average they would represent transfer payments from the community as a whole to mostly high-income commuters. They also seem inconsistent with some of the usual goals of public policy. It seems irrational, for example, that cities with ambitious plans for renewing central areas should grant transport subsidies, which make outlying residential locations even more attractive to high- and middle-income workers -- the same people they are trying to lure back to the central areas by offering them economical new housing in renewal districts. Furthermore, the rail transit proposals for solving the high-income commuting problem probably subsidize and even encourage the continuance of racial discrimination in housing. Specifically, such subsidies might relieve high-income commuters of part of the costs that most people seem to impose upon themselves to avoid

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*Voters of three San Francisco-Oakland Bay Area counties have approved a bond issue to finance a 75-mile trans-bay rail rapid transit system with an estimated capital cost of nearly one billion dollars. The Los Angeles Metropolitan Transit Authority, emboldened by the success of the Bay Area Rapid Transit District in obtaining tax support, has expanded its proposed $300 million, 22.7-mile "Backbone Plan," to a $649 million, 58-mile system. The National Capitol Transportation Agency submitted its report to the President on November 1, 1962, which proposed the construction of an 83-mile, $800 million rail transit system for the Washington, D.C. region and a substantial curtailment of the region's highway program. New rail transit systems are being seriously proposed for Atlanta and Pittsburgh and less seriously for a number of other large metropolitan areas. Moreover, Philadelphia, Boston, Chicago, and New York are seeking Federal subsidies for expansion of existing rail facilities.

residing near Negroes or other minority groups.*

Transit planners have given most of their attention to two groups of transit users: those unable or unwilling to procure private automobile transportation, and the high- and middle-income commuters to the central business districts of major metropolitan centers. Emotional appeals concerning the plight of the first group have been widely used to justify the elaborate rail transit plans proposed in a number of metropolitan areas, but most of them will actually do very little to provide for this group's complex pattern of local trips; on the contrary, these systems are designed to do little more than provide peak-hour commuter service to the high-density workplaces of the high-income groups. The authors and designers of these plans base their hopes, and even their revenue estimates, on the ability of high-speed, high-performance transit facilities to attract an increasing proportion of central business district commuters. For example, the revenue estimates for 1966 used for the Los Angeles "Backbone Plan" are based on a ridership of 38 million passengers, of whom 22 million (or 56 per cent) would be persons diverted from private automobiles. This diversion is to be achieved at the same time that competitive highway capacity in the Wilshire Corridor is significantly increased with the completion of the Santa Monica Freeway, Los Angeles' first east-west freeway. Revenue estimates for other plans assume similar diversions.

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*The terms Negro and non-white are used interchangeably in this paper. Almost all Chicago and Detroit non-whites were Negroes in the years the studies were conducted. In other American cities, however, other minority groups -- Puerto Ricans, Mexican-Americans, etc. -- are victims of residential segregation. The conclusions of this paper concerning the effects of residential segregation on travel and residential behavior apply equally to these minority groups in similar circumstances.

Despite the hopes entertained for these plans, very little is known about the characteristics of central business district commuters or of their travel and residential behavior. It is the purpose of this paper to examine and interpret these behavioral patterns and in particular the inter-relationships between them, for workers employed in the central business districts of Detroit and Chicago, the nation's second and fifth largest metropolitan areas, and to illustrate the usefulness of economic theory in explaining and predicting this behavior.

Section II below develops a simple consumer-choice model which analyzes the tradeoff between housing cost and travel cost to explain the residential choices, residential density, and commuting behavior of workers employed at high-density workplaces in major urban centers. Section II also includes a few simple and fairly obvious empirical tests of such models, using data obtained on this kind of workers from the 1952 Detroit and 1956 Chicago transportation studies.* The primary

*The data describe the attributes and worktrip behavior of nearly 4,000 interviewed households representing approximately 110,000 of Detroit's Central Business District workers (about 100,000 whites and 10,000 nonwhites); nearly 17,000 interviewed households representing approximately 247,000 of Chicago's Central Business District workers; and approximately 296,000 workers employed in the area just adjacent to the Chicago Central Business District.

Original card records were obtained from the Detroit Area Traffic Study and the Chicago Area Transportation Study. The research presented here is part of a larger RAND research project sponsored by the Ford Foundation, analyzing samples of travel data for approximately 40,000 Detroit and 50,000 Chicago households. The study considers only the "first worktrip" made by each sampled household member belonging to the labor force on the day interviewed, and analyzes the journey from home to work rather than the trip from work to home or the round trip. The morning trip was chosen over the evening trip because it is less often "distorted" by side-trips for shopping and other purposes, and thus is more "normal." In addition, the study included only "internal trips" -- defined as trips having both ends within the study area. Since the study area is very large, workers residing outside it make only a small percentage of the total person-trips: 5.3 per cent in Chicago and perhaps 7 per cent in Detroit. The percentage of such trips analyzed in this paper is of course very much smaller, with the exception of the relatively large number of rail trips entering the Chicago Central Business District from outside the cordon.

purposes of these simple empirical tests are to illustrate more clearly the logic of the theoretical framework used in this paper and to illustrate its consistency with widely accepted empirical facts.

Section III elaborates on the simple model in order to incorporate the substantial effects of racial segregation on the residential and commuting behavior of both white and non-white workers employed at high-density workplaces. In particular, it tries to examine how discrimination affects the operation of the housing market and the spatial distribution of urban housing costs. Section III also presents empirical data illustrating some of the substantial effects of racial discrimination on the commuting behavior and residential choices of both whites and Negroes.

Section IV presents more substantial tests of hypotheses obtained from the more elaborate model, incorporating market imperfections and racial constraints. These tests deal primarily with the relationships between residential space consumption and the length of the journey-to-work, and with the relationships between housing costs and the space consumption of whites and non-whites. The worker populations of both the Detroit and Chicago Central Business Districts are stratified by structure type (used as a measure of residential space consumption), by city and workplace location, and by race, to examine the effects of these variables on journey-to-work length and the consumption of residential space. Journey-to-work length is measured in both elapsed time and distance in order to permit evaluation of households' tradeoffs between travel and money expenditures.

Finally, Section V examines the choice of transportation mode in

the context of the substitution of time and money costs in commuting and in terms of the interrelationship between the choice of residential density and the costs in time and money of the alternative travel modes and combinations of modes.

## II. A MODEL OF HOUSEHOLD RESIDENTIAL AND TRAVEL BEHAVIOR

The behavioral hypotheses used here to explain the residential and travel behavior of workers employed in central locations are relatively few and simple. It is hypothesized that households try to maximize their total real income in what is undoubtedly an imperfect way; that is, it is assumed that households try to obtain their preferred set of consumer services at lowest possible cost. It is also argued that the length of a worker's journey-to-work, and thus the distance he resides from his workplace, largely depend on a cost tradeoff between transportation costs and housing costs.*

The essence of this tradeoff is that while workers employed at central locations can lower their housing costs by living farther from their workplaces, they increase their travel costs by doing so. The second relevant aspect of this tradeoff is the fact that the magnitude of such savings in housing cost increases with the amount of residential space the worker consumes. This consumption is roughly measured by the density at which the worker resides, greater space consumption being associated with residence in lower-density structures. The utility-

*A more complete and rigorous presentation of this model may be found in John F. Kain, The Journey-to-Work as a Determinant of the Residential Choices of Detroit Households, The RAND Corporation RM-3581-FF (to be published); and idem, "The Journey-to-Work as a Determinant of Residential Location," Proceedings of the Regional Science Association, 1961.

maximizing worker lives at that distance from his workplace where the money he saves in housing costs by undertaking a longer journey-to-work is just offset by increased travel costs.

The assumption that the portion of housing costs variously referred to by other authors as "location," "site," or "position" rents decline with distance from major workplace agglomerations is crucial to the explanation of household travel behavior developed in this paper.* These location or site rents are economic rents which landlords may obtain from households for sites more accessible to major workplace agglomerations. These rents exist because of households' collective efforts to economize on transportation expenditures. Location rent surfaces having these properties have been obtained in a number of theoretical writings.** All these writings have assumed away or ignored the questions of depreciation, obsolescence, housing-quality differentials, and similar problems of housing-market dynamics.

It seems probable that a surface of location or site rents would be very complex and that location rent surfaces might differ for various types of accomodations (those of varying quality, density, age, etc.)

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*See, for example, Edgar M. Hoover and Raymond Vernon, Anatomy of a Metropolis, Harvard University Press, Cambridge, Mass., 1959; William Alonzo, "A Theory of the Urban Land Market," Papers and Proc. of the Regional Sci. Ass., University of Pennsylvania, Philadelphia, Pa., 1960; John D. Herbert and Benjamin H. Stevens, "A Model for the Distribution of Residential Activity in Urban Areas," J. Regional Sci., Vol. 2, No. 2, Fall 1960; Lowdon Wingo, Jr., Transportation and Urban Land, Resources for the Future, Inc., Washington, D. C. 1961; and Ira South Lowry, "Residential Location in Urban Areas," unpublished Ph.D. dissertation, Department of Economics, University of California, 1960.

**See, for example, Alonzo, op. cit., and Wingo, op. cit.

The quasi-rents obtainable in one submarket defined by, say, quality differences, might differ substantially from those obtainable in another. Market disequilibrium may well be the rule rather than the exception, since there are major imperfections in the market for real property, and since housing is both durable and non-homogeneous.

Although there is apparently no empirical information that permits direct evaluation of the hypothesis that location rents in the various submarkets differ, there is some inferential evidence. For one thing, some kinds of residential services may be difficult or impossible to secure by renovating single units of the existing stock of housing. For example, if large lots, high levels of community services, and other than gridiron street patterns are highly preferred residential attributes, it would very likely take wholesale demolition and redevelopment to achieve them in the older built-up portions of cities. Since large lots are rare in old residential areas near the central business district, the price of large-lot residential services might vary by a greater amount with distance from the central business district and other workplace agglomerations than would the price of small-lot residential services. Thus if there are two submarkets, one defined by modern, high-quality, large-lot residential structures, and another defined by obsolete, low-quality, small-lot structures, the incremental savings obtainable with distance from major workplaces might well be much greater in the former than the latter. In either case, however, we would expect the price for units in either submarket to decline with distance from the central business district. Furthermore, even given the above reservation, there is no obvious reason why systematic price differentials between the

various submarkets, in the absence of very serious market imperfections, should persist for long periods of time. Housing services can be either upgraded or downgraded. Downgrading can occur through density-increasing conversions, permissive deterioration, and failure to maintain and renovate structures. Upgrading can occur by renovation, demolition and reconstruction, and by other forms of private market renewal.*

Since the workers dealt with in this paper are employed in the central areas of Chicago and Detroit, where urban employment densities are highest, we would expect their housing costs per unit of residential space to decline with distance from the center. Because Chicago and Detroit differ in size and in the numbers employed in their central business districts (about two and a half times as many in Chicago as in Detroit), it would seem reasonable to expect, assuring our provisional hypotheses about the determinants of location rents are valid, that location or site rents would be higher in Chicago than in Detroit at each distance from the central business district. Specifically, for the purpose of the empirical testing in this paper, it is postulated that the price per unit of residential space of a stated quality and amenity decreases monotonically with distance from the center, but that the price is consistently higher for Chicago. Thus it is postulated that central workers in both cities may reduce their housing costs per density-unit by commuting longer distances, but that the savings per mile will be larger for Chicago workers.

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*Society Hill and Rittenhouse Square in Philadelphia, and Capitol Hill and Georgetown in Washington, are frequently cited examples of private market renewal. They are also costly examples.

It is also crucial that in making longer journeys-to-work, households incur larger costs in both time and money. Since time is a scarce commodity, surely workers demand some compensation for the time they spend in commuting.* Both the distance and the time a central business district worker will commute thus depend on his valuation of commuting time, the money-cost of his commuting, and the savings in housing cost he is able to obtain from a longer journey-to-work. He will extend his distance only so long as his savings in location rent offset or just equal his increased expenditures of time and money.

His reductions in housing cost, however, depend not only on his commuting distance, but also upon the quantity or the amount of residential space he consumes. If he lives in very-low-density residential quarters, his cost savings per unit of residential space are multiplied by a large number of units; if he chooses very-high-density quarters, his savings may be small. For many people housing-cost savings obtained from longer journeys-to-work may be quickly offset by increasing travel costs.

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*The problem of valuing travel time is extremely complex. Nearly all benefit-cost analyses of urban transportation systems include a value of travel time as part of an analysis of alternative systems. Savings in travel time invariably swamp all other benefits in such analyses. Nonetheless, no one has devised an adequate empirical measurement of the value of time. Transportation studies invariably use some wage rate to value travel time, on the assumption that the value of commuting time is equal to the wage rate. Moses and Williamson have pointed out the theoretical difficulties inherent in such a procedure in two papers which represent the best theoretical statement of the problem. See Leon Moses, "Economics of Consumer Choice in Urban Transportation," paper presented at Dynamics of Urban Transportation, A National Symposium sponsored by Automobile Manufacturers, Assoc., Inc., October 23-24, 1962; and Leon Moses and Harold F. Williamson, Jr., "Value of Time, Choice of Mode, and the Subsidy Issue in Urban Transportation " (unpublished manuscript); see also Fred Hoffman, "Route Choice and Valuation of Travel Time" (unpublished).

Unless the labor forces of Detroit's and Chicago's central business districts differ greatly in their socio-economic composition, the simple economic model used in this paper would predict that Chicago workers' trips, measured by both elapsed time and distance, should exceed those of Detroit workers. As noted previously, we would expect larger savings in housing costs to be obtainable from commuting a given distance in Chicago than in Detroit, at every level of residential space consumption. Thus, if transportation costs in Chicago and Detroit are at all comparable, Chicago workers would be expected both to commute farther and to spend more time commuting. Precisely this relationship is shown in Fig. 1: 50 per cent of Detroit's central business district workers can get home by traveling 5 miles or less, and 30 minutes or less; only 32 per cent of their Chicago counterparts live that nearby, and only 34 per cent can get home within 30 minutes.

Just as certainly, the simple consumer-choice model predicts that Detroit workers will consume more residential space since it costs less than in Chicago. Fig. 2 illustrates the comparison, measuring residential space consumption according to the structure type of residence. It is assumed that the greatest amount of space is consumed by single-family units, followed by two-family units and multiple units. Both findings are well known and obvious empirical relationships. They are presented here because they are consistent with the consumer-choice model previously discussed, and because they illustrate the tradeoff between housing cost and travel cost.

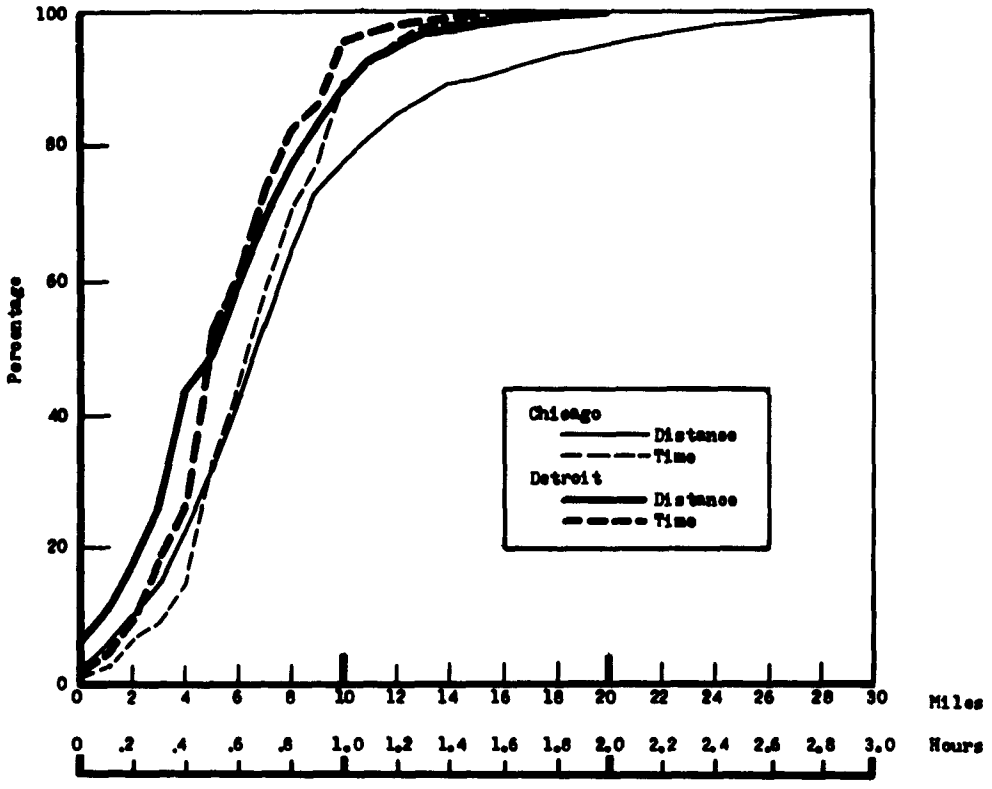


Fig. 1 — Cumulative Percentage Travel Times and Distances for Chicago and Detroit CBD Workers

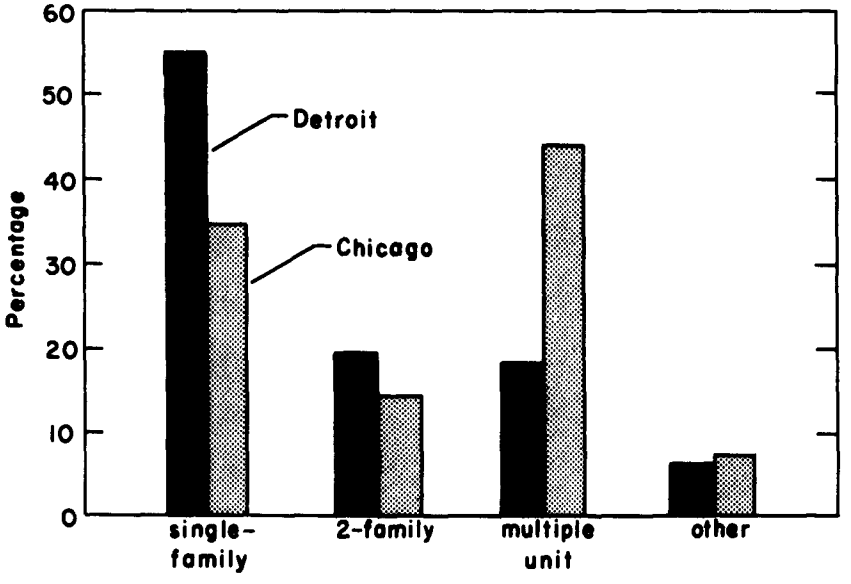


Fig. 2 -- Percentage of Chicago and Detroit Central Business District Workers Residing in Each Structure Type

## III. HOUSING-MARKET DISCRIMINATION AND THE COMMUTING OF NEGROES AND WHITES

In the absence of serious housing-market imperfections, it is possible that the simple model presented in Sec. II could explain household behavior adequately, especially if elaborated in terms of the heterogeneity of residential services according to attributes other than location, and in terms of the effect on travel and housing costs of other trips made by household members.*

A far more serious omission of the model as presented thus far is its failure to consider explicitly the effects of racial discrimination on commuting and residential location. Any theory or model of the worktrip and residential location behavior of urban households, if it pretends to be realistic and reasonably complete, should explicitly consider these effects, since racial discrimination in the housing market is an enormous market imperfection with great influence on the commuting and residence patterns of both whites and non-whites.

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*As an example of the latter, the housing-cost/travel-cost tradeoffs of households with two or more wage-earners must include all of their combined journey-to-work costs. Similarly, other kinds of frequently made trips may significantly affect the level of combined travel and housing costs for some households.

Racial discrimination may be thought of as a constraint on the housing-cost/transportation-cost tradeoff model discussed previously. Discrimination severely limits the range of choice in which non-whites are able to exercise the market calculus described above. In addition, the division of the market into two submarkets (a "free market" for whites, with unrestricted location choices, and a "segregated market" for non-whites) affects the prices of housing services at various locations. Where such imperfections prevail, the schedule of location or site rents would be expected to differ from that hypothesized previously or obtained in the theoretical writings previously mentioned.*

Price levels in both submarkets are determined largely by supply and demand forces, but the determinants of these forces differ considerably between the two. The salient feature of both submarkets is the fact that existing housing stock makes up most of the supply. Each year's new construction is but a fraction of the total. A second important feature of the supply schedule is that the housing services

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*Wingo, op. cit., Alonzo, op. cit.

represented by the stock are locationally fixed and all but impossible to move to other locations. Urban development has usually occurred incrementally with distance from a single dominant center; as a result, the age distribution of the housing stock varies systematically with location.

Chicago and Detroit have a single dominant nucleus and several much smaller sub-centers around which some peripheral growth has occurred and around which, as a result, some older structures are located; but the overwhelming majority of older structures are found in and around the central business districts. The segregated market in Detroit and Chicago, as in most United States metropolitan areas, is mostly located around this dominant center in which has frequently been referred to as the "the grey area." Thus nearly all the structures in the non-white market are of prewar construction.

Recent additions to the housing stock have been predominantly of two kinds: new lower-density structures on the periphery, and high-rise and other high-density structures at more central locations.

A ceiling on free market rents and housing prices is established by the cost of providing new housing services, i.e. the cost of new construction. Of course, the costs of producing new housing vary considerably from one location to another. The greatest difficulties are due to variations in land costs, and the greatest of these are between the costs of vacant and non-vacant land. Site costs of developed sites are equal to the discounted value of the income streams of existing properties plus demolition costs. Thus it is hardly surprising that demoliton is seldom carried out by the private market

except to provide sites for very-high-density and high-quality apartment developments in areas where there is substantial excess demand for them, or to provide sites for industrial or commercial use.

In any case, a price ceiling exists for any type of free market housing, dependent on the costs of providing the desired services in a new structure or location and the differential travel costs between each site and peripheral sites. From the earlier discussion, it is clear that price differences equal to travel-cost differences may exist between two locations without providing an incentive for a household to locate in the lower-cost area. The overwhelming importance of the stock also causes a certain asymmetry in this market; price ceilings exist for each type of housing service, but no floor, excepting the chain of substitutes and the ability to modify the supply characteristics of the existing stock. Conversions, renovations, redecorating, and permissive deterioration are methods used by landlords and home-owners to change the configuration of the supply of housing services to correspond to changes in the configuration of demand in order to maximize their rental income.

Since non-whites are almost entirely banned from outlying residential locations, price determination in the segregated market differs in a number of important ways from that in the free market. The price ceiling established by the cost of new fringe construction is almost entirely absent for the segregated market. The ceiling established by the cost of new construction in built-up areas still exists, but as in the free market, it is likely to be operative only at price levels considerably above those established by new construction on vacant land

Demand for residential services in the segregated market is determined by forces similar to those in the free market. The major demand determinants for housing services in metropolitan areas during the post-war period have been increases in metropolitan populations, increases and redistribution of employment, rising incomes, and cheaper and more available housing credit. Increases in the non-white demand for residential services in urban areas were especially substantial during and after the war as large numbers of rural Southern Negroes and of Puerto Ricans migrated to cities. Unlike whites, who can locate anywhere, non-whites are mostly confined to areas allocated to them by convention, collusion, and the like.

While many of the same possibilities for adjusting the supply exist in the segregated as in the free market, such as the widely used device of density-increasing conversions, supply determinants in the segregated market are still considerably different. Since new construction is insignificant in the segregated market, nearly all additions to its housing supply must come from spatial expansion of the segregated market. Such expansion primarily results from very substantial increases in the non-white demand for housing services; it usually consists of peripheral growth -- almost never of the creation of "islands" in all-white areas. Thus, the prices and changes in their level in the segregated market depend almost entirely on the relative growth of the non-white demand within an urban area, and the rate at which the segregated market is permitted to expand.

If demand far exceeds supply in the segregated market, as it did during and immediately after World War II, rents and housing prices

are sure to rise. Wartime controls on building materials and construction kept the supply of urban housing services relatively constant. At the same time, migration to cities and higher incomes caused demand to soar, especially in the segregated market, generating enormous increases in densities and sharp increases in price levels.

The post-war housebuilding boom slowly eased the supply situation and larger peripheral expansions of the segregated market were allowed. Large price differentials between the two markets gave whites an incentive to put housing on the segregated market. They used the profits to purchase more or better housing services elsewhere. The result was a fairly rapid expansion and consolidation of the segregated market which may have erased the former price differentials. It seems likely, however, that a positive differential still remains and undoubtedly will remain as long as effective segregation persists, the reason being that the non-white market expands only as the result of demand pressures. Unless a Negro is willing to pay somewhat more for a particular location than is a white, white owners and landlords are unlikely to sell or rent to him. Therefore, barring a sharp decrease in non-white demand, price levels in the segregated market will probably continue to be higher than in the free market.

This conclusion runs counter to views widely held and accepted by real estate brokers and white homeowners. For example, it is still commonly believed that property values plummet when Negroes move into a white neighborhood. Such beliefs are consistently refuted by all the systematic empirical investigations the author has encountered,*

*For example, see William M. Ladd, "The Effect of Integration on Property Values," The American Economic Review, September, 1962; and Luigi Laurenti, Property Values and Race: Studies in Seven Cities, Univ. of Calif. Press, Berkeley and Los Angeles, 1960.

but they are still held by lenders and even until recently have been approved by the Federal Housing Authority in its appraisal policies. Their sheer acceptance -- especially by mortgage lenders, whose attitudes so crucially influence the operation of the market -- makes it an omnipresent danger that they will become self-fulfilling prophecies.

The author hypothesizes that discrimination raises the cost of Negro housing above that of similar free market housing, but that housing prices in the segregated market vary inversely with distance from major workplace agglomerations just as they do in the free market. For the empirical testing that follows, it is postulated that (1) housing costs in the segregated market are higher at every distance from the central business district than in the free market, (2) that Detroit housing costs in the segregated market are lower than those in Chicago at each distance, and (3) that housing costs per unit of residential space of a given quality decrease with distance from the central business district in each of the four markets.

The nearly absolute restriction on non-white residential location is illustrated in Figs. 3 and 4, depicting the residential areas of Detroit and Chicago. The data shown in the two figures represent the non-white percentages of the total number of workers residing in each area during the study years. Given these spatial patterns of housing segregation, the reader can easily perceive that whites and non-whites in both cities differ significantly in the distances and elapsed times of their journeys-to-work. The effects of these constraints on Negro residential choice are partly shown in Fig. 5, which graphs the percentages of Chicago and Detroit whites and Negroes residing in each

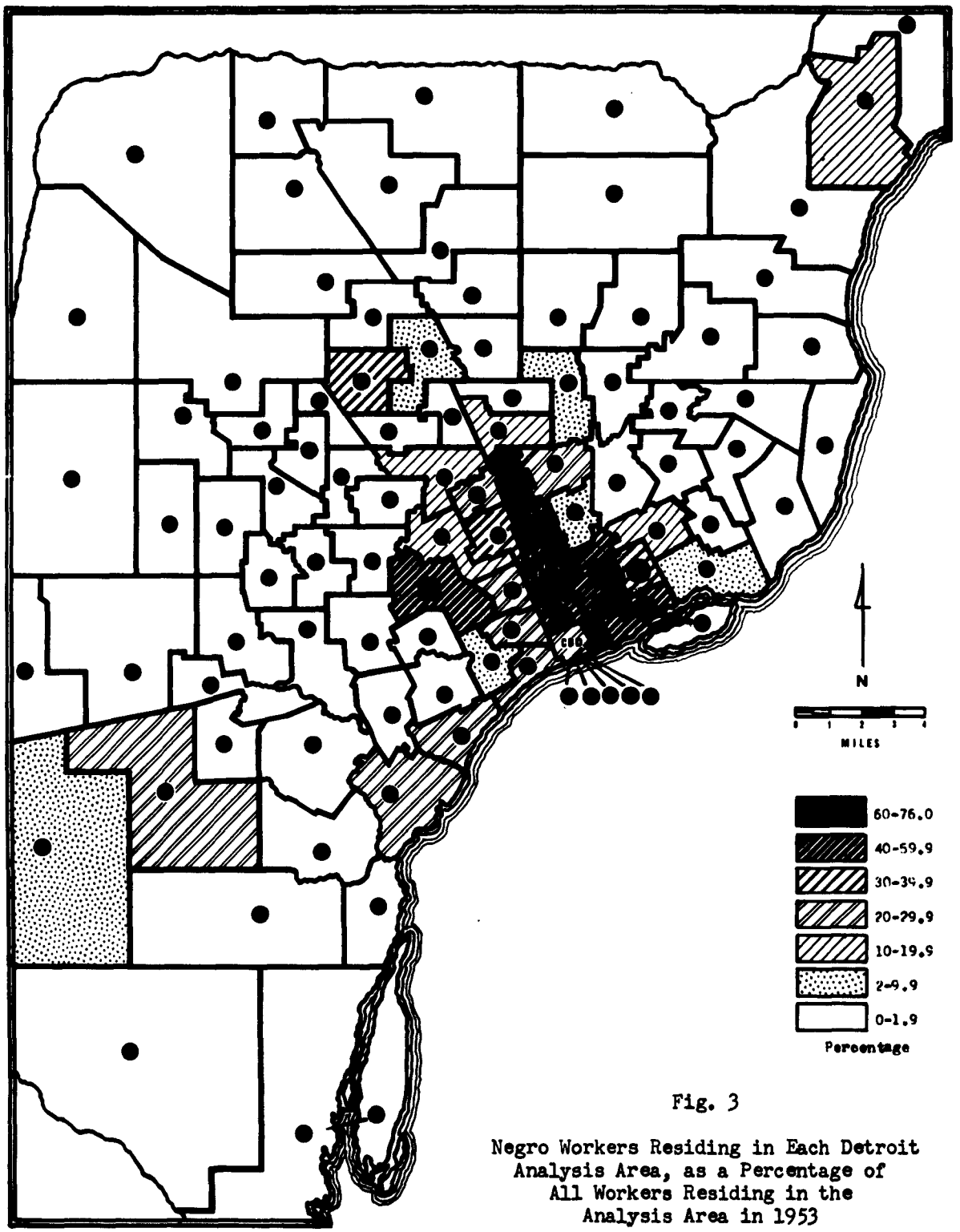
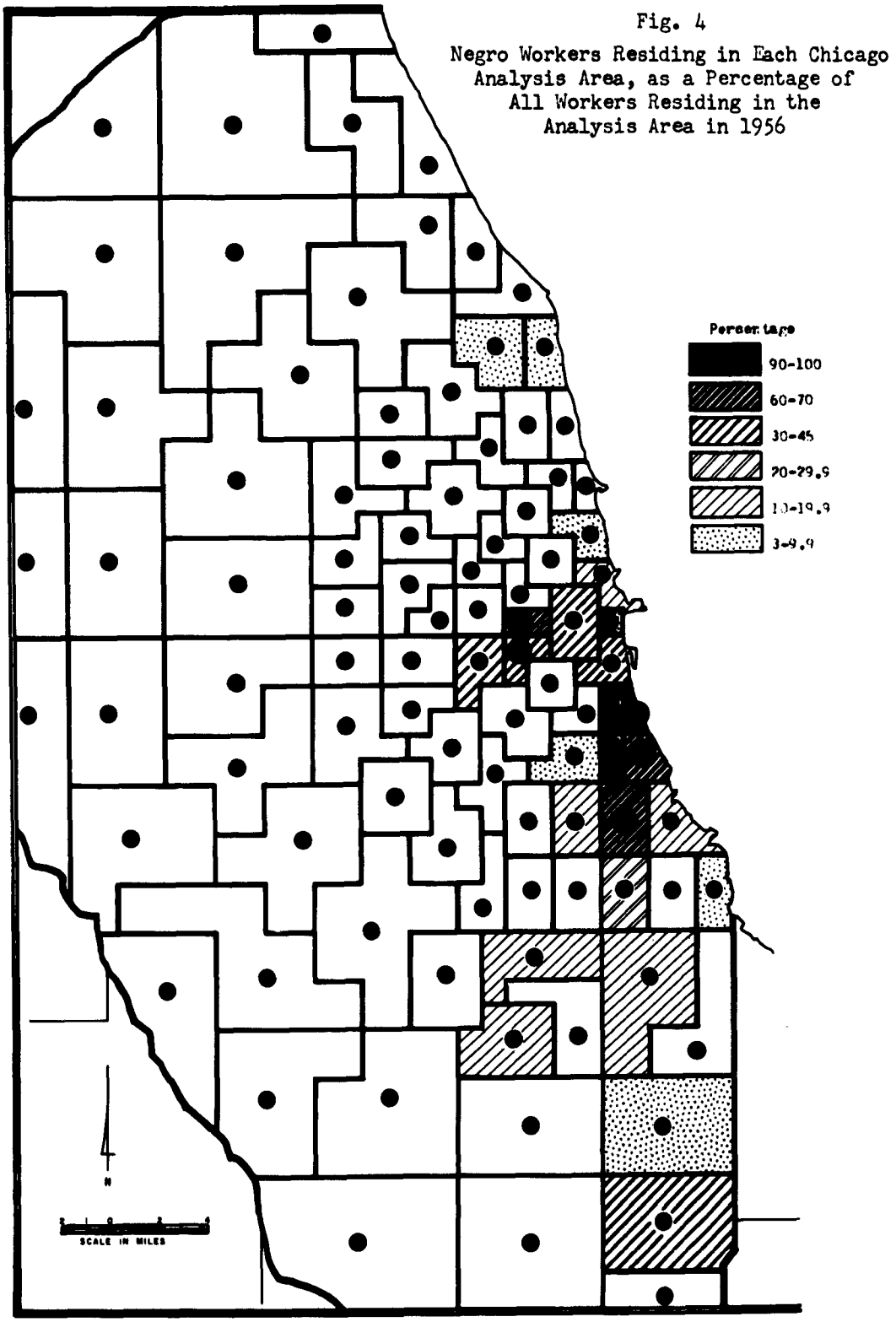



Fig. 3

Negro Workers Residing in Each Detroit Analysis Area, as a Percentage of All Workers Residing in the Analysis Area in 1953

Fig. 4
Negro Workers Residing in Each Chicago Analysis Area, as a Percentage of All Workers Residing in the Analysis Area in 1956



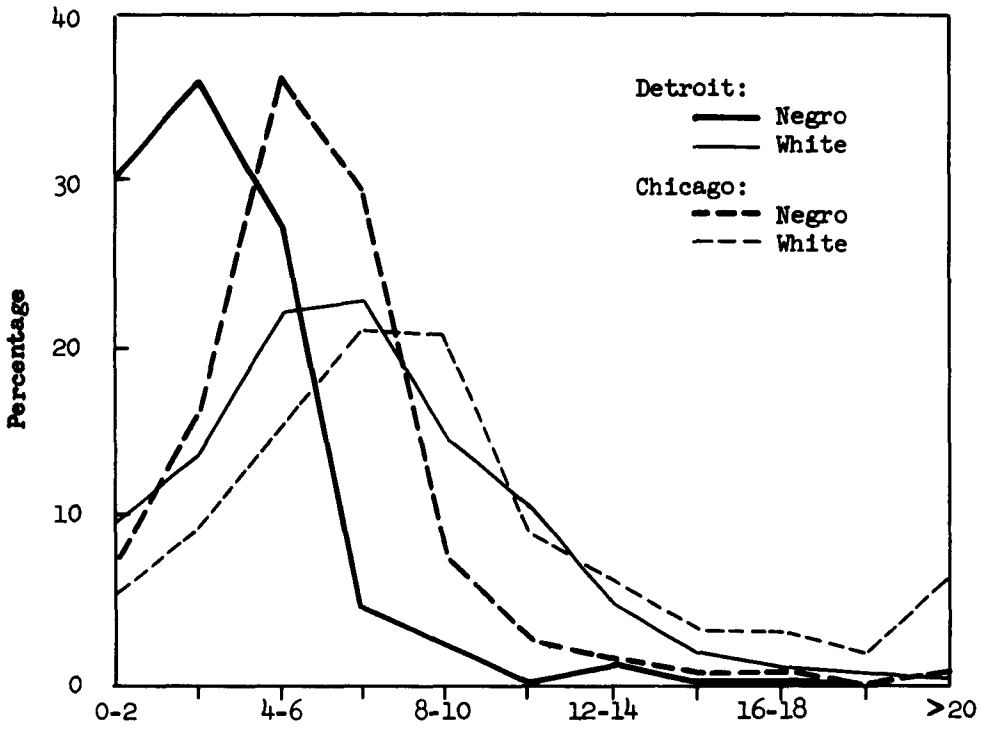



Fig. 5 -- Percentage of White and Negro CBD Workers Residing in Each Two-Mile Distance Ring from the Chicago and Detroit CBD's

two-mile-distance interval from the central business district in which they work. The similarity in the patterns for the two cities is almost uncanny. The only significant difference is that the peaks of the distributions are about two miles closer to the central business district in Detroit than in Chicago. In Detroit, 36 per cent of the Negro labor force in the central business district reside between two and four miles of the district; in Chicago, almost an identical percentage reside between four and six miles of the Loop. About 22 per cent of Detroit's white workers reside in each of the distance intervals, 4-6 miles and 6-8 miles; only about one per cent less of their Chicago counterparts reside in each of the 6-8 and 8-10 mile intervals. These striking similarities prevail despite the fact that the two cities differ substantially in metropolitan population, central business district employment, industrial composition, area, period of most rapid development, residential density, and most other attributes that affect travel and residential patterns.

The discrepancy in the distances at which the profiles peak is due largely to differences in central business district employment levels and in metropolitan scale. For the same percentages of central business district workers to live within a given distance in both cities, the residential density of Chicago's workers would have to be several times as great. This is accentuated by the fact that in Chicago the quantity of and percentage of the total area that is devoted to non-residential use near the central business district are several times as great as in Detroit.

Despite the great differences in the non-white and white residence

profiles shown in Fig. 5, the full effect of segregation on non-white commuting patterns is still greater than suggested there. From Fig. 4 it is apparent that the few Negro residences in the outlying areas of Chicago are distributed very unequally. A large majority of Chicago Negroes live in the dismal South Side. Discrimination's full effects on the commuting of Negro central business district workers may be seen more clearly in Figs. 6 and 7, residential distributions of workers of both races employed in Chicago's central business district and in Sector 0 surrounding it.

Segregation also affects the residential choices of whites, many of whom have a dual motivation: to avoid living near non-whites, and to reside in areas with prestige. In Chicago, these preferences no doubt help explain the high proportions of whites employed in the central business district and Sector 0 who reside in Sectors 1 to 3 (especially in Sector 1, which includes Chicago's Gold Coast, Evanston, and other high-status areas), and the lower proportions residing in Sectors 4 to 7 (especially Sector 7, the predominantly Negro South Side).

Fig. 6

Percentages of Chicago White and Nonwhite CBD Workers Residing in Each Sector -- 1956

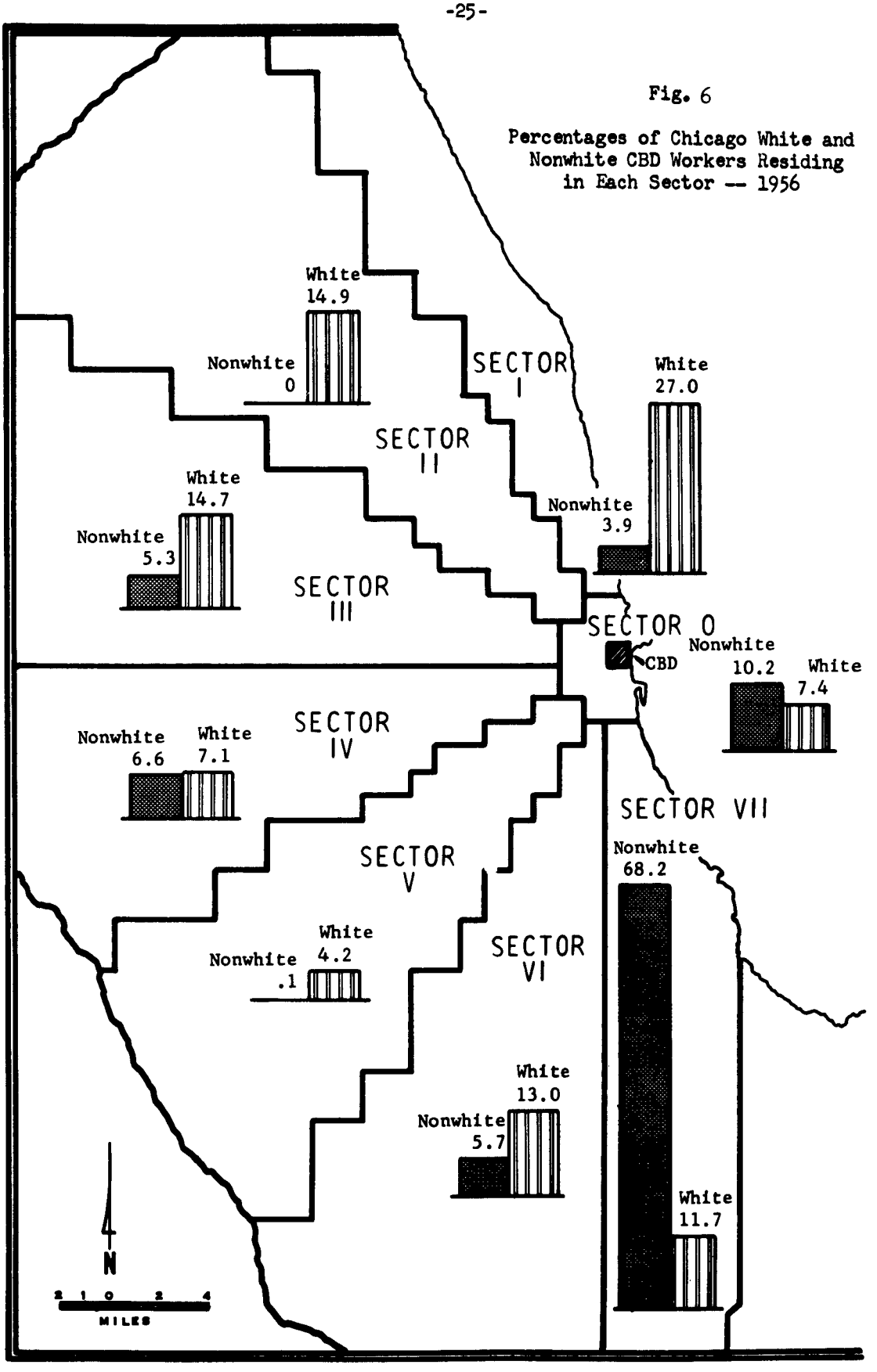
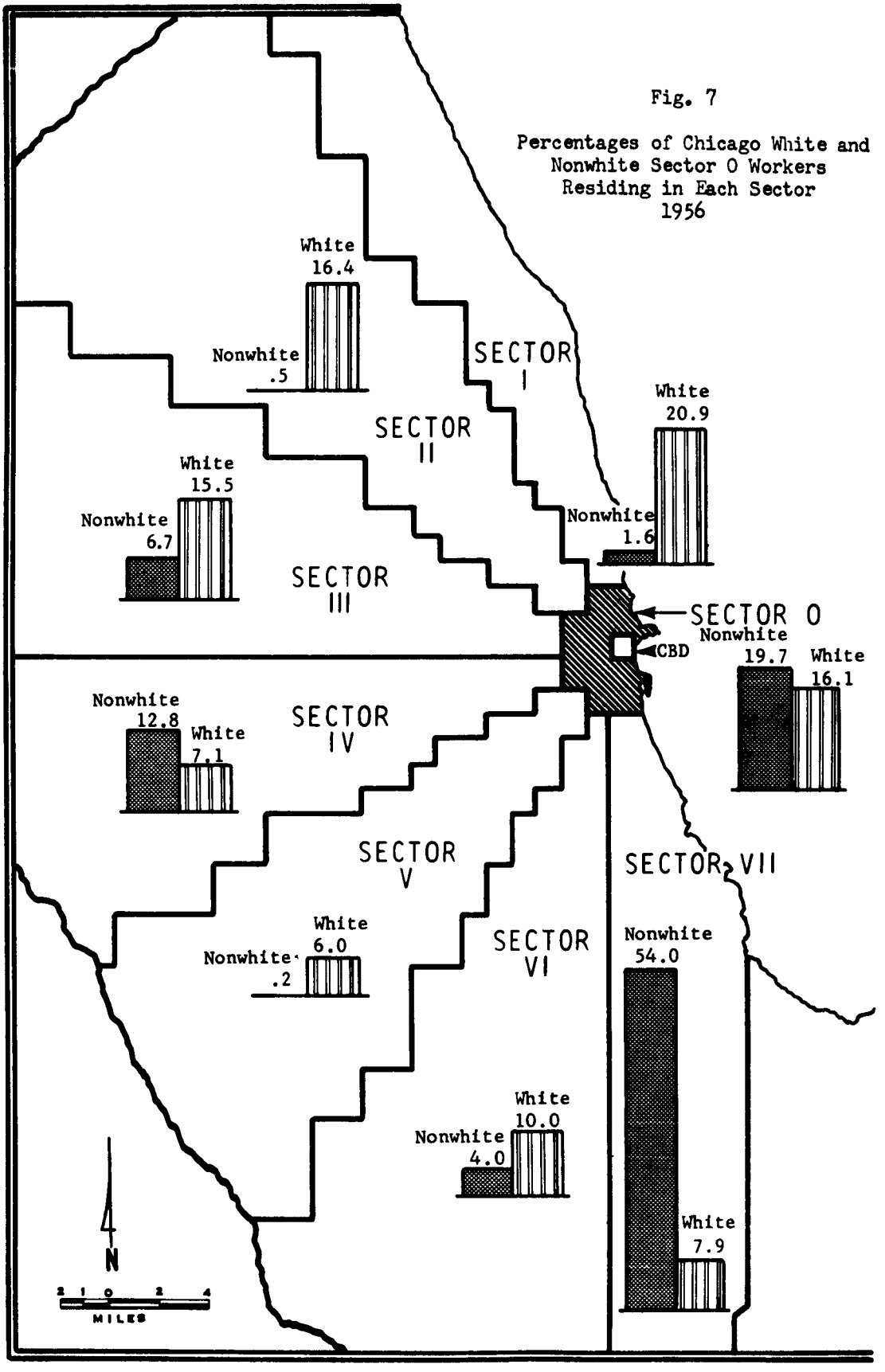


Fig. 7

Percentages of Chicago White and Nonwhite Sector 0 Workers Residing in Each Sector 1956



## IV. RESIDENTIAL SPACE CONSUMPTION AND THE LENGTH OF THE JOURNEY-TO-WORK

It was postulated above that workers who prefer to live in lower-density structures are able to economize the most on housing costs by commuting longer distances. If the postulate is true, the author would expect their journeys-to-work to be longer than those of other workers employed in the same workplaces. Similarly, since residential space is postulated to cost more for Chicago's than for Detroit's central business district workers, we would expect to find that Chicago's workers residing in each structure type consistently make longer worktrips than those of their Detroit counterparts. Table 1 confirms this expectation; for both races, in fact, worktrip length increases as the density of the structure type decreases. Holding city and structure type constant, whites uniformly commute longer and spend more time commuting farther than do non-whites.

The simple consumer-choice model underlying the analysis also predicts, if the two cities' central business district workers do not have significantly different incomes and space preferences, that Detroit's workers will consume more than Chicago's, and whites more than Negroes. Table 2 lists the relevant percentages for various structure types, revealing, among other things, that the percentage of Chicago whites residing in multiple units is more than twice that of Detroit whites. From this fact the author concludes that the higher price (minimum-cost combination of commuting costs and location rents) that Chicago workers must pay for residential space discourages them from consuming it.

Table 1

CHICAGO AND DETROIT CBD COMMUTERS TRAVELING LESS THAN THE GIVEN ELAPSED TIMES AND AIRLINE DISTANCES, BY RACE AND STRUCTURE TYPE

| Quartile and Structure Type | Distance | | | | Elapsed Time | | | |
|---|---|---|---|---|---|---|---|---|
| | White | | Negro | | White | | Negro | |
| | Chi | Det | Chi | Det | Chi | Det | Chi | Det |
| 1st quartile | | | | | | | | |
| 1-family | 7.7 | 5.0 | 4.0 | 1.8 | 6.4 | 4.5 | 5.1 | 3.3 |
| 2-family | 4.3 | 3.1 | 3.3 | 1.2 | 4.8 | 4.0 | 4.2 | 3.0 |
| Multiple | 3.5 | 1.7 | 3.2 | 0.3 | 4.2 | 2.9 | 3.9 | 2.3 |
| 2nd quartile | | | | | | | | |
| 1-family | 10.5 | 7.1 | 7.1 | 3.2 | 8.3 | 6.2 | 7.3 | 4.5 |
| 2-family | 6.0 | 4.5 | 5.4 | 2.4 | 6.6 | 4.9 | 5.8 | 4.4 |
| Multiple | 5.7 | 3.1 | 4.5 | 1.6 | 5.5 | 4.4 | 4.8 | 3.8 |
| 3rd quartile | | | | | | | | |
| 1-family | 15.3 | 9.4 | 9.4 | 4.1 | 9.9 | 7.9 | 8.9 | 6.1 |
| 2-family | 7.8 | 6.0 | 7.4 | 3.5 | 8.2 | 7.1 | 7.5 | 5.9 |
| Multiple | 7.6 | 4.5 | 6.0 | 2.9 | 7.2 | 5.6 | 6.4 | 4.9 |

Part of the racial difference in residential space consumption in both Chicago and Detroit is possibly due to differences in incomes and preferences; however, the author concludes that most of it is due to the higher costs of residential space and restricted choices in the market for real property.

## V. SUBSTITUTION OF TIME AND MONEY EXPENDITURES IN COMMUTING

Tradeoffs between housing and travel costs are not the only alternatives available to urban households in attempting to maximize their real incomes. Journey-to-work travel costs have two components: dollar costs and time costs. Commuters to the central business district may choose among fairly numerous transportation media in Detroit, and

even more in Chicago, with widely varying time-and-money costs. The relative costs among the media partly depend on distance traveled and on the household's choice of residential density. This choice, as discussed previously, strongly affects the amount a worker can save in housing costs by commuting longer distances. The numerous transportation media can also be used in combination to provide still more alternative time and money costs.

Table 2

PERCENTAGES OF CHICAGO AND DETROIT WHITE AND NEGRO CBD WORKERS RESIDING IN VARIOUS STRUCTURE TYPES

| Structure Type | White | | Negro | |
|---|---|---|---|---|
| | Chicago | Detroit | Chicago | Detroit |
| Single-family | 36.5 | 58.4 | 9.2 | 30.2 |
| Two-family | 15.0 | 18.2 | 9.5 | 30.0 |
| Multiple | 41.4 | 17.4 | 73.0 | 28.7 |
| Other | 7.1 | 6.0 | 8.3 | 11.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

If we consider only out-of-pocket costs, and if parking is free, the dollar costs of a rail commuter and of a lone automobile commuter to the Chicago central business district are very similar; parking charges and car pooling, however, greatly affect the out-of-pocket costs of automobile commuting. These costs, for a single auto commuter paying $1.00 a day for parking, exceed rail commuting costs by about $0.80 a day, assuming no collection or distribution charges for the rail commuter. If these costs are shared by two persons,

auto commuting costs 20 per cent less for a trip to and from a residence area 20 miles from the Loop.

The level of transportation service, the amount of inconvenience and delay, and the portal-to-portal time of commuting by alternative travel media largely depend on the density of the worker's residence and workplace. Chicago's central business district has a combination of an unusually high level of transit service and high parking charges, both stemming from its very high workplace density. The result is a high rate of transit use: 80 per cent of the central business district's workers arrive there by some form of transit. The lower rate in Detroit -- 53 per cent -- is attributable to lower parking charges, lower levels of transit services, and lower average residential density. Both high workplace and high residential densities usually mean more frequent transit service with wider coverage. Thus there is a high probability that a worker employed at a very-high-density workplace, such as the CBD, and residing in a very-high-density residential area, will find it cheaper to use transit than to travel by auto. The probability is much lower for a worker employed at the same workplace but residing at a lower density, and it is nearly zero for a worker having both a very-low-density workplace and a low-density residence. Table 3, which lists the percentages of Detroit workers using transit by workplace ring and structure type of residence, illustrates just this relationship. Reading the table from top to bottom, we find that the average workplace density and thus the level of transit service at workplaces decreases; and reading from left to right, we find that the average residential density and thus the average level of transit service also decreases. The

transit-use outcomes in Table 3 are just those that would be predicted if the probability of transit use were expressed as the joint probability of use at the workplace and at the residence, where the independent probabilities were positively related to workplace and residence densities. The scatter diagram, Fig. 8, illustrates the relationship between automobile use at the origin of the worktrip (either as an auto driver or a rider) and the percentage of workers

Table 3

PERCENTAGES OF DETROIT WHITE WORKERS USING TRANSIT, BY WORKPLACE RING AND STRUCTURE TYPE

| Workplace Ring (Higher to Lower Workplace Density) | Structure Type (Higher to Lower Residential Density) | | |
|---|---|---|---|
| | Multiple | Two-family | One-family |
| 1 | 60.7 | 58.7 | 50.6 |
| 2 | 28.5 | 28.6 | 19.5 |
| 3 | 29.4 | 23.1 | 18.9 |
| 4 | 27.3 | 23.1 | 14.1 |
| 5 | 17.8 | 11.1 | 8.4 |
| 6 | 5.8 | 4.1 | 3.5 |

residing in single-family dwelling units, for all Chicago workers. From Fig. 8, it is clear that those residence areas having fewer single-family units and thus lower residential densities tend to have lower transit use at the origin for worktrips.

Even among those CBD workers in Chicago who reside in low-density structures, the vast majority are discouraged from commuting by auto all the way to work, because of the high employment density and high parking charges in the CBD, and the high levels of service and

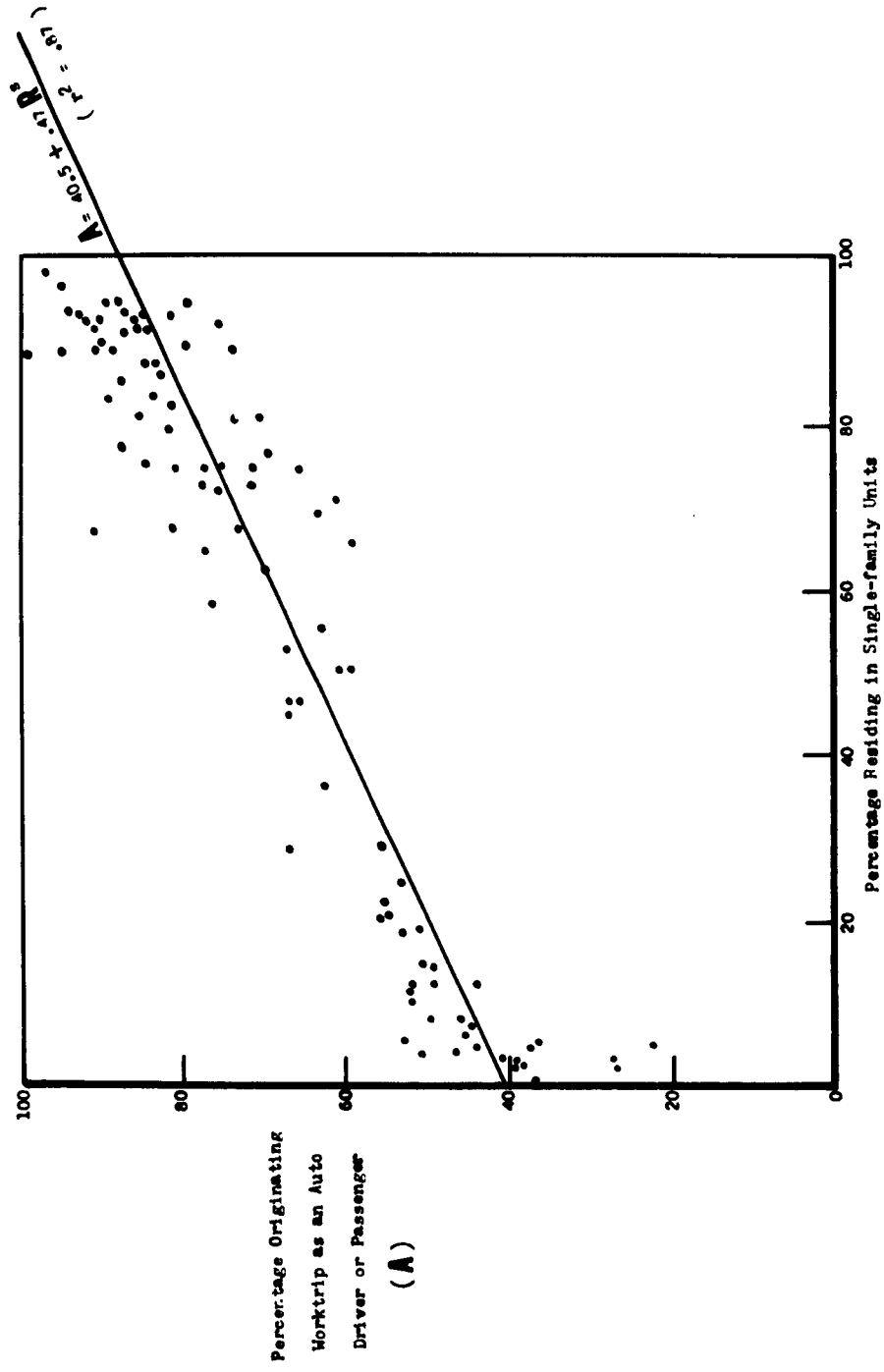



Fig. 8 — Percentage of Auto Commuters in Each of Chicago's Residence Areas, by the Percentage of the Area's Single-family Dwelling Units

abundant capacity provided by rapid transit and commuter railroads. Typically, those residing in single-family units combine the use of private automobiles, either as drivers or passengers, with commuter rail or, slightly less often, rapid transit. Table 4 illustrates the relationship for Chicago between choice of mode combinations and the decision to reside at various densities, as measured by structure type. For example, 85 per cent of those who are combined auto passengers and rail commuters, and 82 per cent of those who are combined auto drivers and rail commuters reside in single-family units; only 6 and 9 per cent of those groups, respectively, reside in multiple units. As pointed out previously, the dollar-cost and time-cost properties of these combination modes cause them usually to have the highest cost and highest average speed of all of the combination modes shown in Table 4.

The lowest-money-cost, lowest-speed-mode combination included in Table 4 is undoubtedly the combination of the local bus at residence and the local bus at workplace; only 17 per cent of those using this combination reside in single-family structures, while 51 per cent reside in multiple units, and 15 per cent in other dwelling units (which usually have the highest densities of all).

The interpretation offered here for the differences in the rates of use of the combinations listed in Table 4 is that they are the result of the cost-minimization, utility-maximization calculus described previously. The large housing-cost savings per mile traveled for those residing at the lowest densities encourages them to travel long distances. As the distance traveled increases, the time savings

obtainable from using modal combinations with higher speed encourages long-distance commuters to spend more money to reduce travel time. In addition, as residential density decreases, the time-costs of using various of the modes as residential collectors -- rail and

Table 4

PERCENTAGES OF CHICAGO CBD WORKERS RESIDING IN VARIOUS STRUCTURE TYPES, BY TRAVEL MODE COMBINATIONS

| Origin Mode | Destination Mode | Structure Type | | | | Total |
|---|---|---|---|---|---|---|
| | | One-family | Two-family | Multiple | Other | |
| Auto driver | Auto driver | 40.0 | 13.9 | 40.2 | 5.9 | 100.0 |
| Auto driver | Rail | 81.9 | 8.1 | 8.8 | 1.2 | 100.0 |
| Auto driver | Rapid | 56.3 | 22.0 | 21.7 | 0 | 100.0 |
| Auto driver | Bus | 63.6 | 7.4 | 27.1 | 1.9 | 100.0 |
| Auto pass. | Auto pass. | 28.3 | 13.4 | 50.9 | 7.4 | 100.0 |
| Auto pass. | Rail | 85.4 | 6.9 | 5.5 | 2.2 | 100.0 |
| Auto pass. | Rapid | 60.6 | 13.5 | 25.2 | 0.7 | 100.0 |
| Auto pass. | Bus | 77.7 | 9.5 | 12.8 | 0 | 100.0 |
| Rail | Rail | 47.4 | 9.7 | 38.4 | 4.5 | 100.0 |
| Rail | Rapid | 76.0 | 6.0 | 18.1 | 0 | 100.1 |
| Rail | Bus | 57.5 | 1.9 | 29.0 | 11.6 | 100.0 |
| Rapid | Rapid | 11.4 | 13.3 | 67.6 | 7.7 | 100.0 |
| Rapid | Bus | 12.4 | 30.9 | 43.7 | 13.0 | 100.0 |
| Bus | Rail | 54.7 | 20.5 | 20.2 | 4.6 | 100.0 |
| Bus | Rapid | 31.9 | 25.3 | 40.8 | 2.0 | 100.0 |
| Bus | Bus | 17.4 | 16.2 | 51.1 | 15.3 | 100.0 |
| All modes | | 36.5 | 14.8 | 41.1 | 7.6 | 100.0 |

rapid transit in particular and, to a lesser extent, bus -- increase rapidly, usually making the private auto the most economical way of originating the trip.

The situation is somewhat different for a great many people who choose to commute entirely by local bus. Their decision to reside at high density causes their potential housing-cost savings from

commuting longer distances to be small. These small potential savings dictate minimal transportation expenditures in both time and money. Since terminal time makes up a very large proportion of total time spent on short trips by all modes, the travel-time savings obtainable from the faster, more costly travel combinations are often too small to justify the larger dollar expenditures. Moreover, many small space consumers employed in the Chicago central business district can use the relatively high-speed rapid-transit mode for the entire trip and walk to residences located near the rapid transit line; of those using rapid transit for the entire trip, the percentage residing in multiple units is higher than that for any other travel model combination: 68 per cent.

The relatively small percentage of all-auto commuters and of all-auto-rider commuters residing in single-family units (40 and 28 per cent respectively) suggests the interpretation that a majority of auto commuters to the Chicago central business district use their autos for work-associated purposes.*

The importance of autos and buses as residential collectors for the higher-volume grade-separated facilities is to be seen from Table 5, which gives the percentages of Chicago central business district workers residing within the cordon area and using each mode at their residences, and the percentages arriving in the central business district by each travel mode. (Detroit data do not permit comparable

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*This interpretation is supported by the finding that a disproportionate number of both auto drivers and auto passengers to Chicago's central business district and Sector 0 gave "sales" as their occupation.

tabulations, since only the primary mode used was coded.) From Table 5 it can be seen that 20 per cent of the worktrips to the Chicago central business district originate as auto-driver trips, 12 per cent as auto-rider trips, and 39 per cent as bus trips, while only 12.4 per cent of the arrivals represent auto-driver trips, 4 per cent auto-rider trips, and 25 per cent bus trips. Commuter rail, by way of contrast, accounts for 22 per cent of destinations but only 13 per cent of origins; and rapid transit accounts for only 14 per cent of trip origins but over 33 per cent of trip destinations. From Table 6 it is clear that the majority of commuter rail trips which use another mode are serviced at the origin by auto; of the 22 per cent worktrips arriving in the Loop by commuter rail, 9 per cent originate by auto and these are about equally divided between auto driver and auto passenger trips. Auto trips are only about half as important as feeders for the rapid transit lines: of the 34 per cent of destinations accounted for by rapid transit, only about 4.1 per cent begin by auto. Buses are the important collector for the rapid transit system: almost half the 75,000 rapid transit trips terminating in the central business district originate by bus, while only slightly more than one-third of rapid transit trips ending in the central business district originate on the rapid transit line.

A comparison of Tables 5 and 6 will illustrate the combined effect of lower parking fees and slightly poorer transit service on transit use by workers employed in Chicago's Sector 0. It can be seen that while only about 17 per cent of the central business district workers reach their workplaces by auto, either as drivers or

Table 5

PERCENTAGES OF CHICAGO CBD WORKERS USING EACH MODE AT THEIR RESIDENCES AND WORKPLACES

| Travel Mode | Origin | Destination |
|---|---|---|
| Auto driver | 19.9 | 12.3 |
| Auto rider | 11.6 | 9.3 |
| Rail | 13.1 | 22.1 |
| Rapid | 13.7 | 33.5 |
| Bus | 39.2 | 25.0 |
| Taxi | -- | 0.3 |
| Walked | 1.3 | 1.3 |

Table 6

PERCENTAGES OF CHICAGO WORKERS EMPLOYED IN SECTOR 0 USING EACH MODE AT THEIR RESIDENCES AND WORKPLACES

| Travel Mode | Origin | Destination |
|---|---|---|
| Auto driver | 36.8 | 34.3 |
| Auto rider | 10.9 | 8.5 |
| Rail | 4.2 | 6.4 |
| Rapid | 6.9 | 8.6 |
| Bus | 33.9 | 34.0 |
| Walked | 6.6 | 6.6 |
| Worked at home | 1.0 | 1.0 |

riders, more than twice the percentage (43 per cent) of Sector 0's workers do so. Similarly, while 22 per cent of the CBD's commuters arrive by commuter rail, only a little more than 6 per cent of Sector 0's commuters do so, of whom nearly half originate as auto drivers or riders; and only 8.6 arrive by rapid transit as opposed to nearly 34 per cent of Loop employees. The bus is by far the most important transit vehicle for Sector 0 workers: 34 per cent of the worktrip arrivals in Sector 0 are by bus, and 33 per cent of

originations; 29 per cent of these workers ride the bus all the way between home and work.

The percentage distributions for the structure types given in Table 7 suggest how the use-rate of each travel-media combination is affected by workers' choices of residential density, differences in the level of service provided by various modes, and differences in the level of parking charges in the CBD and in Sector 0. Perhaps the features most sharply exhibited in Table 7 are (1) the much greater use of private autos by Sector 0 than by CBD workers, (2) the much greater use of commuter rail in combination with other travel media by CBD workers residing in single-family units than by any other group employed in either CBD or Sector 0, and (3) the minimal use of either rapid transit or commuter rail by Sector 0 workers. The greater distance of a majority of the workplaces in Sector 0 from rail and rapid transit stations than in the CBD, and the lower parking costs in Sector 0, apparently lead to a substitution of private auto commuting for rail and rapid transit commuting by workers who do not live conveniently near a rail or rapid transit line or who place a high value on their travel time. Nearly 43 per cent of Sector 0 workers who reside in single-family units drive private autos between home and work, and over 7 per cent commute the entire distance as auto passengers.

Table 8 illustrates the greater use of transit vehicles, especially buses, by Negroes employed in the CBD and Sector 0. Nearly 45 per cent of Sector 0 whites commute by auto as compared to about 34 per cent of Negroes. Whites also use the longer-distance, higher-speed transit modes much more than Negroes do: nearly 8 per cent of

Table 7

PERCENTAGE OF CHICAGO WORKERS USING EACH COMBINATION OF ORIGIN AND DESTINATION MODES, BY WORKPLACE LOCATION AND STRUCTURE TYPE

A. Central Business District

| Origin Mode | Destination Mode | One-Family | Two-Family | Multiple | % All |
|---|---|---|---|---|---|
| Auto driver | Auto driver | 13.5 | 11.6 | 12.1 | 12.3 |
| Auto driver | Rail | 10.5 | 2.5 | 0.9 | 4.4 |
| Auto driver | Rapid | 3.7 | 3.4 | 1.2 | 2.3 |
| Auto driver | Bus | 1.2 | 0.3 | 0.5 | 0.7 |
| Auto pass. | Auto pass. | 3.4 | 3.4 | 5.1 | 4.2 |
| Auto pass. | Rail | 11.6 | 2.2 | 0.6 | 4.6 |
| Auto pass. | Rapid | 3.2 | 1.7 | 1.0 | 1.8 |
| Auto pass. | Bus | 1.8 | 0.5 | 0.3 | 0.8 |
| Rail | Rail | 16.3 | 8.2 | 10.7 | 12.0 |
| Rail | Rapid | 0.9 | 0.2 | 0.2 | 0.4 |
| Rail | Bus | 1.2 | 0.1 | 0.5 | 0.7 |
| Rapid | Rapid | 4.2 | 12.0 | 20.7 | 13.2 |
| Rapid | Bus | 0.1 | 0.6 | 0.7 | 0.5 |
| Bus | Rail | 1.8 | 1.7 | 0.5 | 1.1 |
| Bus | Rapid | 14.1 | 26.7 | 15.4 | 15.8 |
| Bus | Bus | 11.0 | 24.1 | 27.7 | 22.3 |
| All modes | | 98.5 | 99.2 | 98.1 | 97.1 |

B. Sector 0

| | | | | | |
|---|---|---|---|---|---|
| Auto driver | Auto driver | 42.8 | 36.9 | 33.0 | 34.2 |
| Auto driver | Rail | 4.4 | 0.6 | 0.2 | 1.4 |
| Auto driver | Rapid | 1.1 | 0.5 | 0.2 | 0.5 |
| Auto driver | Bus | 1.8 | 0.1 | 0.1 | 0.5 |
| Auto pass. | Auto pass. | 7.4 | 9.2 | 3.4 | 8.2 |
| Auto pass. | Rail | 3.9 | 0.6 | 0.2 | 1.2 |
| Auto pass. | Rapid | 0.8 | 0.2 | 0.2 | 0.4 |
| Auto pass. | Bus | 2.3 | 0.5 | 0.6 | 1.0 |
| Rail | Rail | 6.5 | 3.0 | 2.5 | 3.4 |
| Rail | Rapid | 0.4 | -- | 0.1 | 0.1 |
| Rail | Bus | 1.2 | 0.4 | 0.4 | 0.6 |
| Rapid | Rapid | 1.8 | 3.6 | 5.1 | 3.9 |
| Rapid | Bus | 1.0 | 1.5 | 4.1 | 2.6 |
| Bus | Rail | 0.9 | 0.2 | 0.2 | 0 |
| Bus | Rapid | 5.0 | 5.9 | 4.2 | 3.6 |
| Bus | Bus | 16.2 | 32.3 | 35.8 | 29.3 |
| All Modes | | 97.5 | 95.5 | 90.3 | 90.9 |

Table 8

PERCENTAGES OF CHICAGO WHITES AND NEGROES USING VARIOUS DESTINATION MODES

| Destination Mode | Sector 0 | | CBD | |
|---|---|---|---|---|
| | Whites | Negroes | Whites | Negroes |
| Auto driver | 36.5 | 24.8 | 12.4 | 10.8 |
| Auto rider | 8.3 | 9.0 | 4.1 | 6.9 |
| Rail | 7.7 | .6 | 23.9 | 4.6 |
| Rapid | 9.4 | 5.4 | 33.2 | 36.5 |
| Bus | 29.6 | 52.2 | 23.9 | 39.3 |
| Walked | 6.5 | 7.1 | 1.2 | |
| Other | 1.7 | 0.8 | 1.2 | 2.0 |

Sector 0 and 24 per cent of CBD whites arrive by commuter rail, as opposed to less than 1 per cent of Sector 0 and less than 5 per cent of CBD Negroes.

## VI. SUMMARY AND CONCLUSIONS

The findings of this paper have considerable bearing on the problem currently being debated of how to provide access to central urban workplaces for high- and middle-income commuters. The paper does not pretend to solve the problem, but it does present some systematic information that should help clarify it.

For example, the paper illustrates the great impact of racial discrimination on the travel behavior and residential location decisions of both whites and non-whites. Discrimination is a central difficulty. It must be dealt with if we are to solve this aspect of the urban transportation problem, whether it be through renewal of central residential areas or by the provision of high-speed rapid transit facilities.

The paper's insights into the determinants of residential location decisions and the choices among transportation media should also be useful in the evaluation of alternative urban transportation policies. Of particular significance is the added understanding of the extreme specialization of the high-speed rail facilities serving the Chicago central business district. Advocates of the rail transit proposals discussed previously tend to advance them as a cure-all for the transportation ills of urban communities; the findings presented here suggest that they are, instead, specific remedies for a small part of the over-all problem, and that their benefits are restricted to a narrow segment of the urban population.

The paper has a more important objective, however: the development and testing of a fairly simple but nonetheless powerful economic model that will be useful in explaining and predicting the travel and

residential behavior of the urban population. The questions considered in this paper have received little economic analysis heretofore; people who have been most closely identified with these problems have tended to discount the usefulness of economic theory and analysis in solving them.

The consumer-choice model described here emphasizes several kinds of economic calculations assumed to be made by urban workers in deciding on the mode or combination of transportation modes they use for the journey-to-work, the distance they commute, the time they spend commuting, and the amount of residential space they consume (or the residential density at which they reside). The model presents these choices as being determined by the minimization of household's urban locational costs, which are the sum of housing costs incurred to reside near work and of work-associated travel costs. The model explicitly considers several kinds of cost tradeoffs available to urban households in maximizing their real income. The first is a tradeoff between higher housing costs and higher transportation costs. Workers employed at high-density workplaces can save on housing costs by commuting longer distances -- but thus increasing transportation costs. The amount they can save on housing costs depends on both the level and rate at which housing costs per residential space-unit decrease with distance from their workplaces and on the number of space-units they consume.

The second important set of tradeoffs embraces the substitution possibilities between travel-time and money-cost expenditures for the journey-to-work. The various modes or combinations of modes have

different money-cost and speed characteristics; these differences provide another opportunity to urban households for utility maximization. Moreover, these characteristics both affect and are affected by workers' decisions about residential density.

The model also deals explicitly with the effect of racial discrimination on the operation of the housing market and on the decisions of white and non-white households about their travel and residential behavior. Housing-market discrimination is treated as a constraint on non-white behavior which also systematically affects the preferences of whites among alternative residential locations.

Finally, hypotheses suggested by this model are tested empirically using data on work travel obtained from the Chicago and Detroit transportation studies. Over-all, these empirical tests are consistent with the simple economic model used in the analysis. Although incomplete, the model and its empirical testing suggest the likelihood that economic analysis of this type can greatly increase our understanding and thus promote the sounder urban transportation planning we so urgently need.